

ORIGINAL ARTICLE

# Notes on the supertribe Brachineuridi (Diptera: Cecidomyiidae) with description of two new species of the genus *Cingola* Fedotova & Sidorenko from China

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**Abstract** This paper provides the notes on the supertribe Brachineuridi and a review of the diagnostic characteristics of the genus *Cingola* Fedotova & Sidorenko with two new species from China. The generic diagnosis of *Cingola* is revised to give an adequate description and a key to males of all known *Cingola* species is given. Two new species, *Cingola circularis* **sp. nov.** from Henan, Jiangxi and Yunnan, and *Cingola ceratodicrata* **sp. nov.** from Guizhou are described and illustrated. The type specimens were deposited in the Institute of Entomology, College of Life Sciences, Nankai University, Tianjin, China.

**Key words** *Cingola ceratodicrata*, *Cingola circularis*, new species, new record, Brachineuridi, Cecidomyiidae, Diptera, China.

## 1 Introduction

The subfamily Cecidomyiinae (Gagné, 2010) includes four supertribes: Brachineuridi, Cecidomyiidi, Lasiopteridi and Stomatosematidi. Among the supertribe Brachineuridi was promoted by Gagné (1994). During the course of the research on gall midges of Brachineuridi, we think it is the main diagnosis of Brachineuridi and Cecidomyiidi from Lasiopteridi and Stomatosematidi that the gonocoxite having mediobasal lobe neither sublobing nor clasping aedeagus, while Brachineuridi is easily distinguishable from Cecidomyiidi by having 10 flagellomeres each with only one node and seventh and eighth tergites both reduced to a linear band in male. According to the diagnosis above, Brachineuridi (Gagné, 2010) should be revised by removing the genus *Acinacistyla* Fedotova & Sidorenko to Ledomyiini (Lasiopteridi) at least for the reason of the gonocoxite having mediobasal lobe with one sublobe clasping aedeagus (Jiao *et al.*, 2013), and removing the three genera *Compositola* Fedotova & Sidorenko, *Kovaleviola* Fedotova & Perkovsky and *Spungisiola* Fedotova & Perkovsky to Lasiopteridi, the last two of which have been proposed by Gagné (2010).

Gagné (2010) provided four synapomorphies for Brachineuridi, of which the important one (gonocoxite having mediobasal lobe undeveloped with several setae) is not applicable to all the genera in Brachineuridi. Because for the revised Brachineuridi by removing four genera to Lasiopteridi as our proposal mentioned above, there are still one particular group (*Brachyneurina* group), including *Brachyneurina* Mamaev, *Cingola*, *Undoneura* Fedotova & Sidorenko and *Volsatiola* Fedotova & Sidorenko is distinguishable from the other typical Brachineuridi genera (*Brachineura* group) by the developed mediobasal lobe of gonocoxite, which is close to ones of Cecidomyiidi. And with the similar

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morphological characters, the genus *Novocalmonia* Ozdikmen is much close to the *Brachyneurina* group too. So the question is coming, whether the *Brachyneurina* group should continue being placed in Brachineuridi or erect the new supertribe to achieve one monophyletic “Brachineuridi” (Brachineuridi *s. str.*). We think it is appropriate to continue placing the *Brachyneurina* group in Brachineuridi temporarily, considering this group with the same flagellomeres to Brachineuridi *s. str.* and lacking of sufficient research with poor species and less-known biology. And in view of the relationship to Cecidomyiidi with various feeding habits, the *Brachyneurina* group may not be absolutely mycophagous though the biology of most species is unknown.

The tegment between hypoproct and aedeagus of male genitalia is presented commonly in Lestremiinae *s. lat.* (Catotrichinae, Lestremiinae *s. str.* and Micromyinae), Porricondyliinae and some genera of Cecidomyiinae, such as *Odontodiplosis* Felt and *Trisopsis* Kieffer. When researching gall midges of Brachineuridi, we have found some genera with developed tegment too, such as *Cingola*, *Effusomyia* Fedotova and *Rhizomyia* Kieffer. And we continued finding: *Stomatosema* Kieffer and most genera of other Cecidomyiidi with small tegment; *Didactylomyia* Felt with undeveloped tegment which is almost invisible; Lasiopteridi without visible tegment. By contrast, the mediobasal lobe of gonocoxite exits mainly in Cecidomyiinae. Therefore, there are good reasons to presume in Cecidomyiidae: tegment evolves by degeneration from older mycophagous Lestremiinae *s. lat.* and Porricondyliinae to various Cecidomyiinae. Oppositely, the mediobasal lobe, which has the close connection to tegment, mainly evolves by developing in Cecidomyiinae, and Tastás-Duque (2000) placed “paramere” instead of both “mediobasal lobe” and “tegment” to show the analogical sense. We think that mediobasal lobe and tegment of male genitalia may both play an important role in reinforcing the aedeagus to mate successfully and our lab will continue the detailed research about the structure and function.

Fedotova & Sidorenko (2006) established the monotypic genus *Cingola* including *Cingola certa* from Primorskii Territory, Russia and placed it in the tribe Brachineurini. Gagné (2010) placed *Cingola* in the supertribe Brachineuridi. So far, there have been no more records of this genus since Fedotova & Sidorenko (2006). As our research on Brachineuridi, first records of *Cingola* from China with two new species were discovered. We describe the two species and provide the photos and illustrations in this paper including a key to males of all known *Cingola* species.

## 2 Materials and methods

Specimens of the two new species were collected by Malaise traps and catching nets. Adult specimens were preserved in 70% ethanol in the field as soon as collected. For morphological observation, some of the ethanol preserved specimens were mounted on slides in Canada balsam. The morphological terminology follows Gagné (1981). The holotype and other type specimens were deposited in the Institute of Entomology, College of Life Sciences, Nankai University (abbreviated as NKUM), Tianjin, China.

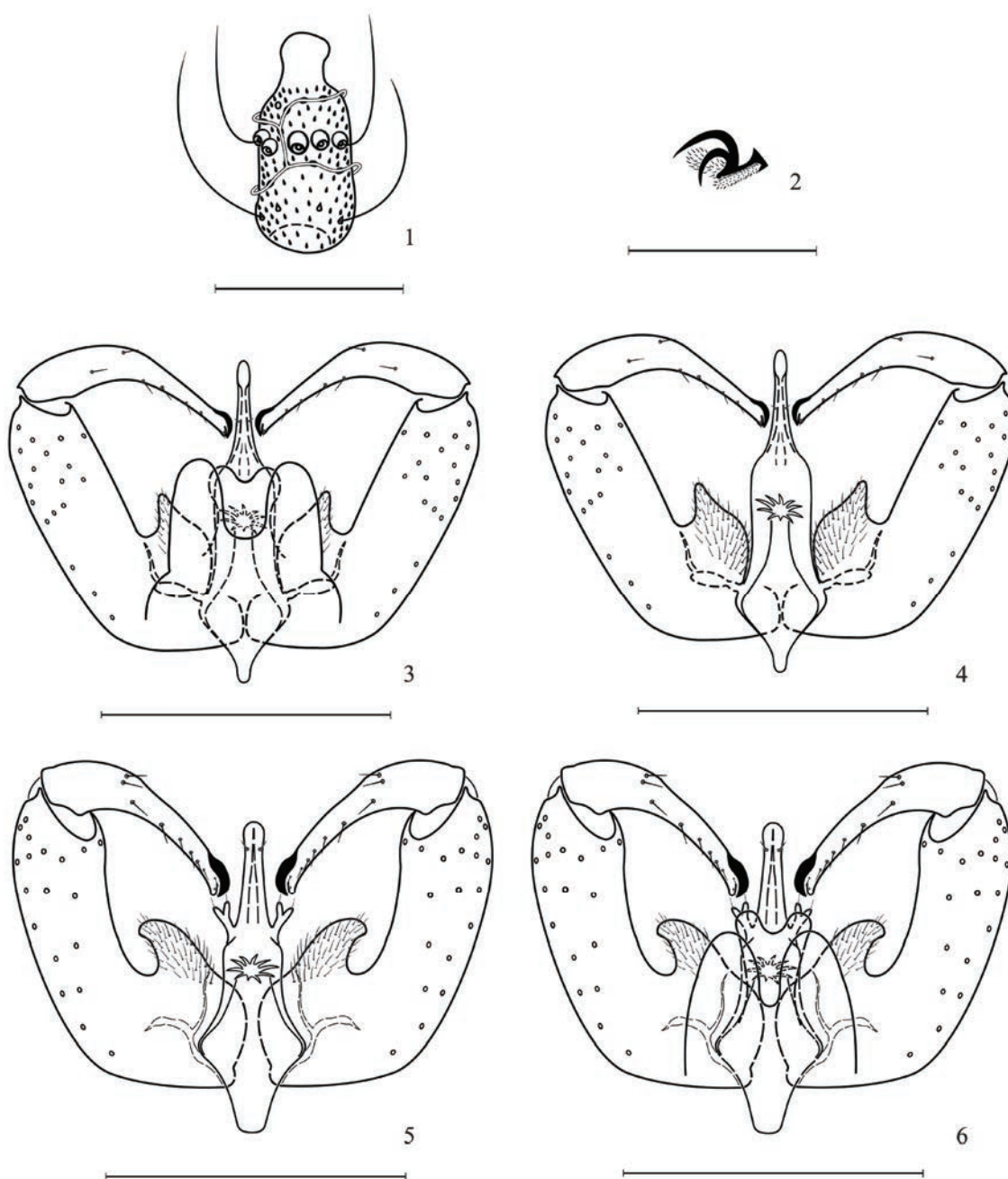
Figs 1–6 are line drawings, Figs 7–17 are photographed by microscope and photomontaged by Auto-Montage software (Helicon Focus 5.3 Pro); all the figures are based on holotypes (slide numbers: NKUCecid. No. BAK001 & BAKK001) except Figs 1–2 and 7 on paratypes (slide numbers: NKUCecid. No. BAK002 & BAK003).

## 3 Genus *Cingola* Fedotova & Sidorenko, 2006

*Cingola* Fedotova & Sidorenko, 2006: 96. Type species: *Cingola certa* Fedotova & Sidorenko (original designation).

### 3.1 Generic diagnosis

Adult. Eye bridge 4 or 5 facets long in the middle of vertex. Male palpus (Figs 8, 12) with palpiger and 3 segments, last two segments longer than first one. Antenna with 10 flagellomeres, each with shorter neck and only one basal node. Wing (Figs 10, 14) hyaline, sparsely covered with narrow scales and setose; vein  $R_1$  joining vein C before the half wing, with two pores respectively at basal  $2/5$  and at the apex; vein  $R_5$  bent a little forward, joining vein C anterior to wing apex, at least with one pore at basal  $1/3$ ; vein Cu unforked. Tarsal claw (Fig. 2) toothed on all legs; empodium as long as tarsal claw. Male seventh and eighth tergites (Figs 16–17) both reduced to one strongly sclerotized and linear band. Male genitalia. Gonocoxite with sub-conical and densely pubescent mediobasal lobe; gonostylus slender and arched at basal  $1/3$  to  $2/5$ ; cerci with a deep depression; hypoproct separated with a V-shaped incision forming two rectangular lobes or with a



Figs 1–6. Male. 1–4. *Cingola circularis* **sp. nov.** 5–6. *Cingola ceratodictata* **sp. nov.** 1. 3rd flagellomere. 2. Fore acropod, lateral view. 3, 6. Genitalia. 4–5. Genitalia, cerci and hypoproct removed. 1, 3–6. Dorsal view. Scale bars: 1–2 = 50  $\mu\text{m}$ , 3–6 = 100  $\mu\text{m}$ .

U-shaped depression forming two rounded lobes; aedeagus gradually tapered to apex, with or without prominences on both sides, usually at distal with a pair of sensory setae dorsally on both sides. Female genitalia. Ovipositor short and not protrusible; cerci separated with two short lobes.

### 3.2 Remarks

The genus *Cingola* is characterized by the uniqueness of gonostylus strongly arched inwardly at basal 1/3 to 2/5 in the

*Brachyneurina* group as well as in *Brachineuridi*. It is also distinguishable from the other *Brachyneurina* group by having sub-conical mediobasal lobe of gonocoxite (not hemispheric or spheric), and it is different from the other *Brachyneurina* group by hypoproct separated with distinct depression forming two lobes, while the other *Brachyneurina* group having hypoproct without depression or just with little depression.

Including two new species in this paper, *Cingola* consists of three species in which *ceratodictata* distributed in the Oriental Region, *certa* in Palaearctic Region, and *circularis* both in Oriental and Palaearctic Region. Fedotova & Sidorenko (2006) described *Cingola* and gave a detailed generic diagnosis. In the present paper, the diagnosis is revised to give an adequate description and some parts of the male generic diagnosis are broadened as follows to contain all known *Cingola* species: hypoproct separated with a V-shaped incision or U-shaped depression; aedeagus with prominences or not.

For the diagnosis of female, only *Cingola certa* is known with 2-segmented palpus and plexiform circumfila of flagellomeres, which are rare in the *Brachyneurina* group as well as in *Brachineuridi*, so the two female characters above are not suitable to be in diagnosis above.

Type specimens of *Cingola certa* deposited in Russia were rechecked with the help of Fedotova. It was known as “the male hypoproct of *C. certa* was slightly sclerotized and unpigmented just with common color, but authentically and distinctly stronger sclerotized than cerci” (personal communication with Fedotova). But considering the slightly sclerotized hypoproct is rare in the *Brachyneurina* group, we do not use this character for the diagnosis and key including comparing with the other congeners temporarily.

In the description of *C. certa* by Fedotova & Sidorenko (2006), there were two careless errors which should be corrected as follows: “Basal outgrowths of gonocoxites as long as gonocoxites” to “Basal outgrowths of gonocoxites as long as gonostyli” and “hypoproct sclerotized” to “hypoproct slightly sclerotized”.

#### Key to males of all known *Cingola* species.

1. Aedeagus with a pair of sclerotized, short and forked prominences on both sides.....*C. ceratodictata* sp. nov.  
Aedeagus without prominences.....2
2. Hypoproct separated with a deep V-shaped incision forming two apically rectangular lobes approximately twice as long as wide; cerci separated with a V-shaped incision forming two lobes approximately as long as wide in the middle .....  
.....*C. certa* Fedotova & Sidorenko, 2006
- Hypoproct separated with a U-shaped depression forming two apically rounded lobes as long as wide; cerci separated broadly with a U-shaped depression forming two lobes 1.50–1.65 times as long as wide in the middle.....*C. circularis* sp. nov.

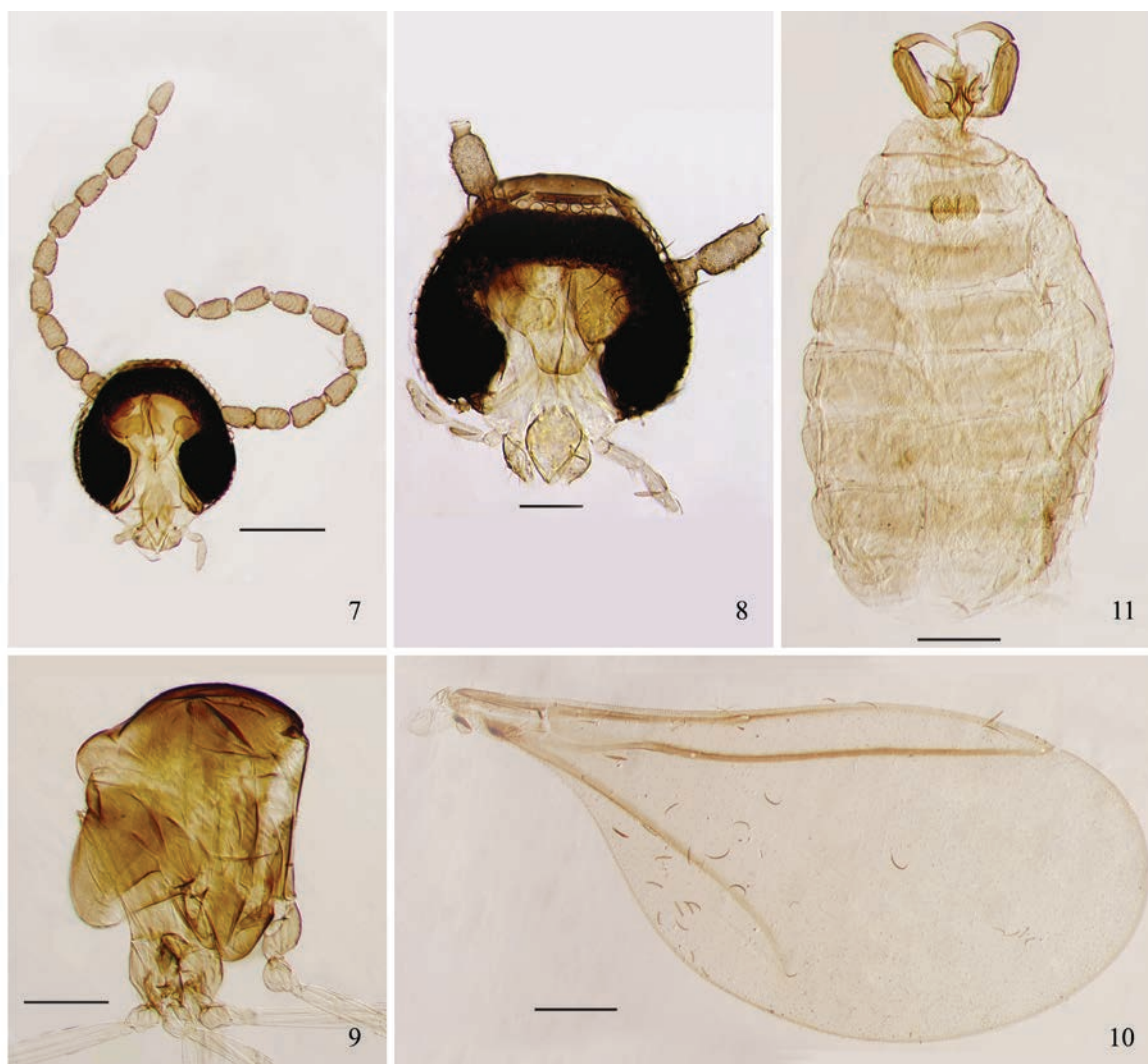
## 4 New species of *Cingola* from China

### 4.1 *Cingola circularis* sp. nov. (Figs 1–4, 7–11, 16)

Male. Body colour brown. Body length 0.85–1.05 mm ( $n = 8$ ). Wing length (measured from the base) 0.75–0.95 mm ( $n = 8$ ). Wing width 0.35–0.45 mm ( $n = 8$ ).

Head (Figs 7–8). Eye bridge 5 facets long in the middle of vertex as in Fig. 8. Palpus sparsely setose, with palpiger and 3 segments, last two segments longer than first one as in Figs 7–8. Antenna (Fig. 7) with 10 flagellomeres; pedicel subglobular, smaller than scape, both densely covered with setae ventrally; node of all flagellomeres subcylindrical, a little broadened subbasally, neck of all flagellomeres shorter; each node with 2 horizontal, appressed, band-shaped circumfila, subapically and subbasally respectively linked by two similar longitudinal circumfila, and 2 whorls of long, strong and irregular setae, one subbasal and one subapical; first and second flagellomeres fused; 3rd flagellomere as in Fig. 1, with the node 1.5–1.8 times as long as wide and the neck 1.2–1.4 times as long as wide, 0.30–0.35 times length of node.

Thorax (Fig. 9). Wing (Fig. 10) hyaline, 2.0–2.2 times as long as wide. Vein Sc weak, C,  $R_1$  and  $R_5$  strong;  $R_1$  joining C before the half wing, with two pores respectively at basal 2/5 and at the apex;  $R_5$  bent a little forward, joining C anterior to wing apex, with two pores respectively at basal 1/3 and near the apex; vein M missing; vein Cu unforked and bent backward, vein PCu parallel with Cu. Legs densely covered with narrow scales and sparse setae; femur of fore-, mid- and hindlegs shorter than tibia, with proportions respectively 0.75–0.85, 0.75–0.85 and 0.80–0.90 times; the second tarsus of fore-, mid- and hindlegs shorter than tibia, with proportions respectively 0.68–0.72, 0.50–0.65 and 0.70–0.80 times. Tarsal



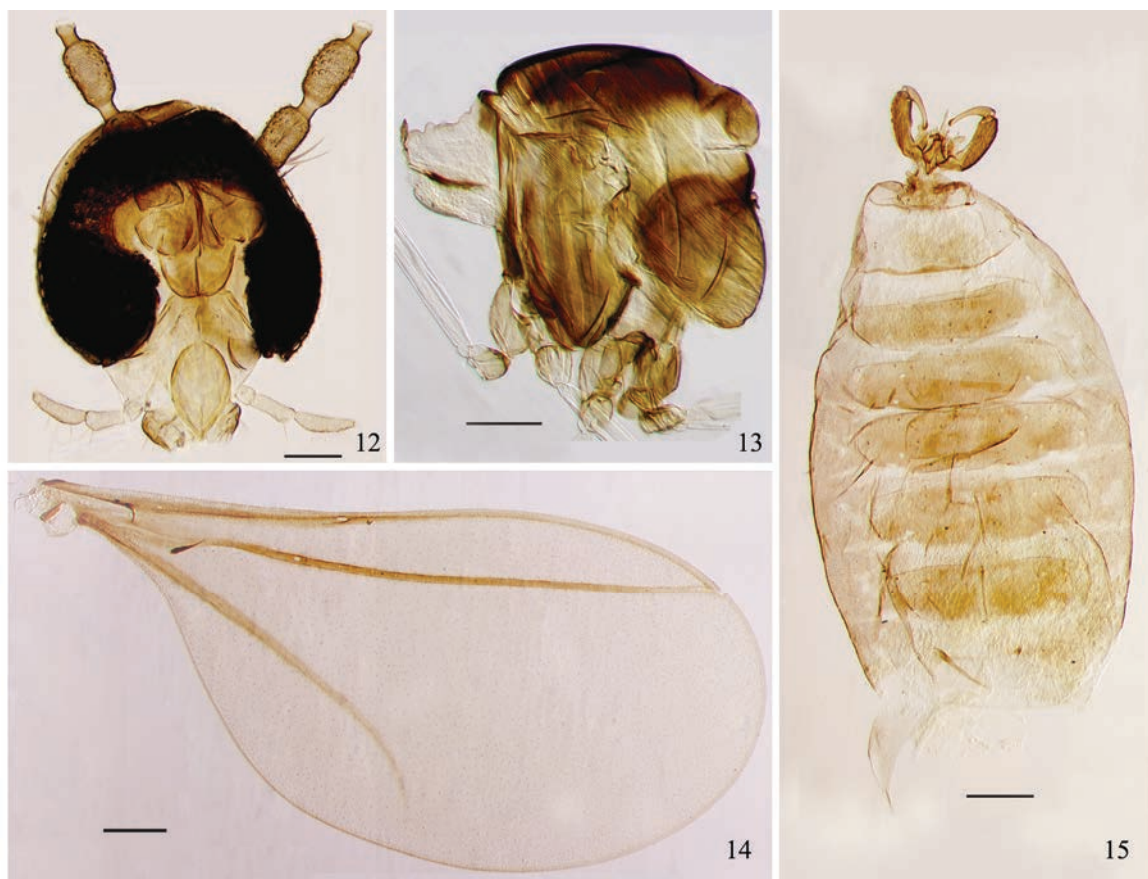
Figs 7–11. *Cingola circularis* **sp. nov.**, male (photomontaged by Auto-Montage Essentials software). 7. Head, anterior view. 8. Head, anterior view, 3rd–10th flagellomeres removed. 9. Thorax, lateral view, wings and legs removed. 10. Wing. 11. Abdomen, dorsal view. Scale bars: 7, 9–11 = 100  $\mu$ m, 8 = 50  $\mu$ m.

claw (Fig. 2) toothed on all legs; empodium as long as tarsal claw; pulvillus cylindrical, 1/2 length of claw.

Abdomen (Fig. 11). Each tergite and sternite densely covered uniformly with scales. 1–6 tergites developed and strip-shaped; first tergite reduced to a thin and latitudinal band, much shorter than second tergite, with an irregular but mostly single row of setae; 2–6 tergites with an irregular but mostly single, posterior row of setae, with respectively 0–3 pairs of lateral setae, and with two pairs of trichoid sensilla including one anterior and one posterior except for sixth tergite only with one anterior pair of trichoid sensilla; seventh and eighth tergites both reduced to one strongly sclerotized, latitudinal and linear band with several scattered setae. 2–8 sternites covered with many scattered lateral and central setae; 2–7 sternites sub-rectangular; 2–4 sternites with an irregular but mostly single, posterior row of setae; 5–8 sternites with an irregular but mostly double, posterior row of setae; seventh sternite shorter than sixth; eighth sternite crescent, shorter and much narrower than seventh.

Genitalia (Figs 3–4, 16). Gonocoxite with slender, protruding and densely pubescent mediobasal lobe having the length approximately 1/3 of aedeagus; gonostylus slender and strongly arched inwardly at basal 2/5, gradually tapering from base to apex, approximately 3/4 length of gonocoxite, covered with a few setae and dense microtrichiae, with one short setae located apically on the inner side, toothed apically; cerci separated deeply and broadly with a U-shaped





Figs 12–15. *Cingola ceratodicrata* **sp. nov.**, male (photomontaged by Auto-Montage Essentials software). 12. Head, anterior view, 3rd–10th flagellomeres removed. 13. Thorax, lateral view, wings and legs removed. 14. Wing. 15. Abdomen, dorsal view. Scale bars: 12 = 50  $\mu$ m, 13–15 = 100  $\mu$ m.



Fig. 16. *Cingola circularis* **sp. nov.**, male (photomontaged by Auto-Montage Essentials software), genitalia and abdominal segments 6–8, dorsal view. Fig. 17. *Cingola ceratodicrata* **sp. nov.**, male (photomontaged by Auto-Montage Essentials software), genitalia and abdominal segments 7–8, dorsal view. Scale bars = 50  $\mu$ m.

depression forming two lobes 1.50–1.65 times as long as wide in the middle, rounded apically with a few long lateral setae; hypoproct not sclerotized, approximately as long as cerci, slightly emarginated, forming two apically rounded lobes approximately as long as wide, each with a few short setae; aedeagus gradually tapered to apex, a little longer than gonocoxite, at distal 1/4 with a pair of sensory setae dorsally on both sides, without prominences on both sides; tegment developed, approximately half as long as aedeagus, gradually tapered to subapex, distally with chrysanthemum-shaped sclerotized structure.

Female. Unknown.

Holotype male. China, Yunnan, Simao (now as Pu'er), Caiyang River Nature Reserve, Mt. Luoluoxinzhai (22.48°N, 100.58°E; alt. 1 500 m), 20 May 2002, Wen-Jun Bu leg., Malaise trap, NKUCecid. No. BAK001. Paratypes: 1 male, *ibid.*, 17 May 2002, NKUCecid. No. BAK002; 1 male, *ibid.*, 27 May 2002, NKUCecid. No. BAK003; 2 males, China, Yunnan, Jingdong, Mt. Wuliang, Manwan (24.4°N, 100.8°E; alt. 1 150 m), 30–31 May 2001, Jun Li leg., Malaise trap, NKUCecid. No. BAK004–005; 2 males, China, Jiangxi, Yifeng, Guan Mountain Nature Reserve, East River Station (27.07°N, 104.09°E), 29 July–1 August 2002, Huai-Jun Xue leg., alt. 1 000 m, Malaise trap, NKUCecid. No. BAK006–007; 1 male, China, Henan, Songxian, Baiyun Mountain Forest Farm (33.66°N, 111.75°E; alt. 1 400 m), 16 July 1996, Jun Li leg., NKUCecid. No. BAK008. All type specimens deposited in NKUM.

Distribution. China (Henan, Jiangxi, Yunnan).

Etymology. The specific name *circularis* means the male hypoproct apically with two rounded lobes.

#### 4.2 *Cingola ceratodicrata* sp. nov. (Figs 5–6, 12–15, 17)

Male. Body colour brown. Body length 1.40–1.50 mm. Wing length (measured from the base) 1.15–1.25 mm. Wing width 0.50–0.60 mm.

Head (Fig. 12). 2nd flagellomere with the node 1.7–1.8 times as long as wide and the neck 0.9–1.0 times as long as wide, 0.26–0.27 times length of node; 3rd flagellomere as *circularis* in Fig. 1. Others as *C. circularis*.

Thorax (Fig. 13). Wing (Fig. 14) 2.1–2.2 times as long as wide.  $R_5$  only with one pore at basal 1/3. Femur of fore-, mid- and hindlegs shorter than tibia, with proportions respectively 0.76–0.79, 0.77–0.79 and 0.79–0.82 times; the second tarsus of foreleg 0.98–0.99 times shorter than tibia. Others as *C. circularis*. Abdomen (Fig. 15) same as *C. circularis*. Genitalia (Figs 5–6, 17): gonocoxite with slender, protruding outward and densely pubescent mediobasal lobe having the length approximately half of aedeagus; gonostylus slender and strongly arched inwardly at basal 1/3; cerci separated deeply and broadly with a U-shaped depression forming two lobes 1.15–1.25 times as long as wide in the middle; hypoproct not sclerotized, a little longer than cerci, slightly emarginated, forming two apically rounded lobes approximately as long as wide, each with a few short setae; aedeagus gradually tapered to apex, a little shorter than gonocoxite, at distal 1/8 with a pair of sensory setae dorsally on both sides, at distal 2/5 with a pair of sclerotized, short, ceratoid and forked prominences on both sides, each apex with one long seta; tegment developed, approximately half as long as aedeagus, gradually tapered to subapex and distinctly wider than *circularis*, distally with chrysanthemum-shaped sclerotized structure. Others as *C. circularis*.

Female. Unknown.

Holotype male. China, Guizhou, Mt. Fanjing, Huguo Temple (27.5°N, 108.4°E; alt. 1 350 m), 28–29 May 2002, Xin-Pu Wang leg., Malaise trap, NKUCecid. No. BAKK001, NKUM.

Distribution. China (Guizhou).

Etymology. The specific name *ceratodicrata* means the male aedeagus with a pair of ceratoid and forked prominences.

## 5 Diagnosis

*Cingola ceratodicrata* sp. nov. is characterized by the uniqueness of aedeagus with a pair of sclerotized, short and forked prominences (Figs 5, 17). *C. circularis* sp. nov. is by hypoproct apically having two rounded lobes and aedeagus not having prominences (Figs 3–4, 16), while *C. certa* is distinguishable from the other two congeners by hypoproct apically having two rectangular lobes approximately twice as long as wide and cerci separated with a V-shaped incision forming two lobes approximately as long as wide in the middle.

*Cingola circularis* is similar to *C. certa* with two pores respectively at basal 1/3 and near the apex in the vein R<sub>5</sub> (Fig. 10), while *C. ceratodictata* only with one pore at basal 1/3 (Fig. 14). However, *C. ceratodictata* differs from *C. certa* and *C. circularis* by the longer mediobasal lobe with the length half of aedeagus (not 1/3 of aedeagus) (Figs 4–5, 16–17).

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